Wood Design & Building®

Spring/Summer 2021 — Number 88

30 Year Anniversary

PARAMETRIC DESIGN

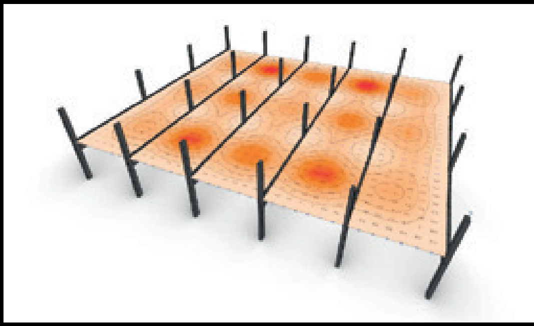
Taiyuan Botanical Garden
A case study by StructureCraft

Intelligent City
On working with robots and algorithms

2020 Wood Design Awards
Merging function, beauty and innovation

Six dollars

Publications Mail agreement #40063877



WOOD DESIGN & BUILDING®

contents

Above and **on the cover:** Taiyuan Botanical Garden includes a restaurant building with an intricate wooden structure
IMAGES: CreatAR, Shanghai / Light Chaser, Taiyuan

And Time Marches Onward…

As 2021 unfolds, the uncertainty of the ongoing pandemic has impacted every industry, with supply chain interruptions and other far-reaching repercussions, including the sudden closure of Katerra. Even so, all is not doom and gloom. At the same time that vaccines are arriving and infection rates are starting to drop, a surprisingly robust industry has seen the announcement of many new mass timber projects worldwide. Some of those are featured in "Projects to Watch" (p.8), and also in our e-newsletter; sign up at WoodDesignandBuilding.com.

Last year, the annual *Wood Design & Building* Awards were delayed, as many things were, and for the first time they were held virtually. We've included the winners in this issue, but this year we also expanded the section to include more information about all categories of awards. Each year, the jurors are impressed with the diversity and excellence of the international entries. It is never an easy choice, as you can see, starting with the Honor winners on p.16.

Along with featuring some of the world's best wood structures, this issue takes a closer look at parametric design. Not only is computer-aided design enabling new ideas, it is helping engineers and architects problem solve and push the limits of many materials, including wood. Two Canadian mass timber innovators, StructureCraft (p.10) and Intelligent City (p.40), explain how computers are helping to generate new possibilities for mass timber.

Long before these advanced technologies, the Canadian Wood Council was founded in 1959, and in 1991, it created this magazine to showcase the many uses of wood. Thirty years ago, when this magazine was first named *Wood le bois*, some of today's commonplace construction methods were barely conceived. Now, with nanoscale wood fibers (see "Wood Ware" on p.50) and algorithms that can generate infinite solutions, the built environment only seems to be limited by our imaginations. As we strive for a more sustainable planet, mass timber is poised to take on a growing role. This magazine has changed considerably over the past 30 years, and it will continue to evolve, just as the industry does. Stay tuned, and stay healthy!

Popi Bowman
Managing Editor

Wood Design & Building magazine invites you to submit your project for consideration and possible publication. We welcome contributed projects, bylined articles and letters to the editor, as well as comments or suggestions for improving our magazine. Please send your submissions to pbowman@dvtail.com.

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WHAT I'VE FALLEN FOR LATELY...

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WOMEN IN ARCHITECTURE, PART 3

Starting with the Fall 2020 issue, we wanted to highlight some of the women in Canada who are leaders, innovators and emerging talents in architecture. Ultimately, we discovered a list so rich in experience and accomplishments, we will continue to highlight these women in the next issue, too!

Ramona Adlakha: A LEED-accredited architect at Diamond Schmitt Architects, Adlakha received a Master's of Architecture from the University of Pennsylvania, where she co-founded Penn Women in Architecture (PWIA). She is an executive member of Building Equality in Architecture Toronto (BEAT) – a national movement to promote equity in design.

Lisa Bate: A principal and the global sustainability lead for B+H Architects, Bate was elected as the first female chair of the Canada Green Building Council in 2014. She also was nominated to the board of the World Green Building Council in 2015, later becoming the first female and second Canadian to chair the organization.

Shirley Blumberg: A founding partner of KPMB Architects (along with **Marianne McKenna**, who was included in the previous edition), Blumberg also was appointed as a Member of the Order of Canada "for her contributions to architecture and for her commitment to creating spaces that foster a sense of community."

Kelly Buffey: A founding partner and principal of Atelier Kastelic Buffey (Akb) Architects, Buffey drives the vision of the studio. Among the firm's many recognitions, most recently the Metrick Cottage and Boathouse received a Canadian Wood Council Award (see p.35).

Joanne Godin: The architect, an associate design director at Montreal's Lemay, has been leading projects for over 25 years.

Valerie Gow: A partner/co-founder at Gow Hastings Architects in Toronto, Gow is also the interior design principal. In collaboration with Two Row Architect, the firm designed one of the 2020 Citation award winners in this issue: the Odeyto Indigenous Centre at Seneca College. The Gow Hastings team also includes architects **Nancy Chao** and **Rebecca Wei**, a LEED-accredited professional (AP).

Janna Levitt: The co-founder of LGA Architectural Partners (formerly Levitt Goodman Architects) had led the firm in many of its award-winning projects, including Laurentian University's McEwen School of Architecture. In 2019, she received the Sustainable Buildings of Canada Lifetime Achievement Award.

Denise Liu: The interior design director for Toronto's Leckie Studio works with a team that includes architects **Emily Dovbniak** and **Ashley Hannon**.

Maya Mahgoub-Desai: The senior urban designer at Moriyama Teshima Architects is also an assistant professor and Chair of Environmental Design at OCAD University.

Marie-Odile Marceau: A partner at McFarland Marceau Architects, Marceau has received numerous awards for contributions to sustainable architecture and Indigenous community design, including the Wood *WORKS!* 2015 Wood Champion Award. The firm's Trades Training Centre at the Northern Lights College won an Honor award in the 2019 *Wood Design & Building* Awards.

Anya Moryoussef: Recipient of this year's RAIC Emerging Architect Award, Moryoussef founded her firm AM_A in 2014. Prior to that, she was an associate at superkül, where Moryoussef was project architect on several internationally recognized and award-winning projects, including Compass House.

Evelyne Paris: The associate architect was on the Lemay team that created the award-winning Bromont Chalet (see p.34), along with design architect **Sarah Perron-Desrochers**.

Birgit Siber: A principal at Diamond Schmitt Architects, Siber led the design installation of the first large-scale living wall biofilter in Canada more than a decade ago at the University of Guelph Humber campus. She also spearheaded ecoMetrics, an energy-use benchmarking databank and analysis tool.

Annabel Vaughan: A project manager at ERA Architects (in Toronto) since 2015, Vaughan works on heritage conservation, small-scale landscape architecture insertions, civic and residential building design, urban design and research, performance art lectures and curatorial projects.

To be continued...

TABBIES 2020 Award Winner

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PUBLISHER ANDREW BOWERBANK abowerbank@cwc.ca

SENIOR MANAGER, MARKETING AND COMMUNICATIONS BARBARA MURRAY bmurray@cwc.ca

SENIOR MANAGER, SPECIAL PROJECTS IOANA LAZEA ilazea@cwc.ca

MANAGING EDITOR POPI BOWMAN pbowman@dvtail.com

CONTRIBUTORS LUCAS EPP, OLIVER DAVID KRIEG, OLIVER LANG, SARAH MACKEL

ASSISTANT EDITORS MITCHELL BROWN, LISA TABACHNICK

ART DIRECTOR SHARON MACINTOSH smacintosh@dvtail.com

ADVERTISING SALES

SENIOR ACCOUNT EXECUTIVE DINAH QUATTRIN dquattrin@dvtail.com 905.886.6641 ext. 308

PRODUCTION MANAGER CRYSTAL HIMES chimes@dvtail.com

DOVETAIL COMMUNICATIONS PRESIDENT SUSAN A. BROWNE sbrowne@dvtail.com

CIRCULATION

PUBLICATION PARTNERS wdesign@publicationpartners.com

SUBSCRIPTIONS

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PUBLICATION PARTNERS
Garth Atkinson
1025 Rouge Valley Dr., Pickering, ON Canada L1V 4N8

Published by:
DOVETAIL COMMUNICATIONS INC.
30 East Beaver Creek Rd., Suite 202, Richmond Hill, ON Canada L4B 1J2
905.886.6640 Toll-free 1.888.232.2881 www.dvtail.com

For:
CANADIAN WOOD COUNCIL
99 Bank St., Suite 400, Ottawa, ON Canada K1P 6B9
1.800.463.5091 www.cwc.ca
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Parametric Design in Action

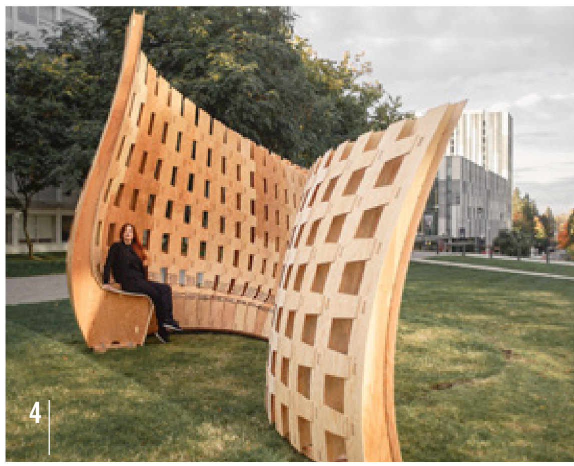
The frontiers of design are often explored in educational facilities, where students and faculty have the freedom to experiment purely for the sake of exploring new ideas and methods of construction. Several innovative examples of parametric design have been produced by university programs, including these:

Institute for Computational Design and Construction (ICD) and the Institute for Building Structures and Structural Design (ITKE) at the University of Stuttgart: For almost a decade, the skeletal structure of sea urchins has inspired a series of the German university's wood projects, culminating in the 2019 BUGA Wood Pavilion, which was created using robotic assembly and a fully automated workflow. Two million lines of custom coding were directly exported from the computational design framework to generate the structure. The highly integrative process enabled the design and engineering of 376 unique plate segments with 17,000 different finger joints and used a robotic assembly platform developed specifically for the project.

SCI-Arc: The Southern California Institute of Architecture is known as one of the world's most innovative independent architecture schools. In 2014, students used parametric methods to create a wood installation for the main entrance using laminar flow principles for the design. The installation consists of 57 hand-cut plywood profiles connected into an internal truss mechanism of 132 disparate pieces, interlocked together, with a total of 6,000 notches; 3,950 linear ft. of hand-cut ¼x¼-in. basswood strips were linked directly to the profiles.

ETH Zurich University: The world's first two-storey wooden pavilion to be built using robots, the Shingled Timber Pavilion was developed during a digital fabrication course where students explored the potential of robotic fabrication to reduce waste. The university also developed Spatial Timber Assemblies, a construction technique that uses robots to produce modular wood structures. ETH recently announced a new Centre for Augmented Computational Design in Architecture, Engineering and Construction, known as Design++, and earlier this year, ETH Professor Emeritus Anne Lacaton and her partner Jean-Philippe Vassal received the Pritzker Prize for their social and sustainable architecture; they have never demolished a building, preferring to restore and rehabilitate properties. (Lacaton is only the sixth woman to receive the Pritzker Prize.)

UBC Centre for Advanced Wood Processing: With courses in robotic timber fabrication and 3D printing with wood (using a wood/polymer composite), this department is part of one of the largest wood science institutions in the world. In 2018, the temporary Wander Wood Pavilion was created in collaboration with professor David Correa (University of Waterloo), using a 3D digital model that was segmented into templates to guide robotic tools. The interlocking wood components were fastened with 2,200 rivets to create the sculptural bench.



1. BUGA Wood Pavilion, ICD/ITKE University of Stuttgart
IMAGE: Roland Halbe

2. Laminar Flow, Sci-Arc
IMAGE: SCI-Arc

3. Shingled Timber Pavilion, ETH Zurich University
IMAGE: Kasia Jackowska

4. Wander Wood Pavilion, UBC
IMAGE: David Correa

PROJECTS TO WATCH

CANADA

In April, B.C. announced provincial funding totaling $4.2 million for 12 mass timber demonstration and research projects, as follows:

- **Happy Harvest Inc. ($475,000):** This 11-storey multi-family residential building will demonstrate the use of mass timber-steel hybrid for affordable rental buildings. The proposed design includes 120 affordable homes, as well as a learning space and community theater.

- **BentallGreenOak (Canada) LP ($500,000):** This 10-storey commercial office building will demonstrate an innovative use of timber brace framing to withstand the effects of earthquakes in a tall building application. The design includes primarily commercial office space with some ground-floor retail and outdoor amenity areas.

- **Reliance Properties Ltd. ($500,000):** A six-storey mixed-use commercial building that demonstrates an innovative use of mass timber-steel hybrid design to renovate a historic building. Built on top of an existing two-storey historic warehouse, the four-storey mass timber addition will provide more density and new commercial office space for the area.

- **District of Saanich ($500,000):** The redevelopment of Fire Station #2 will demonstrate how mass timber can be used in a "post disaster" building designed to withstand emergencies. The project will replace the present one-storey building with a two-storey steel and timber post-and-beam system that will accommodate a fire training tower and emergency vehicles.

- **Bellevue Properties Partnership ($500,000):** This eight-storey multi-family residential building will demonstrate innovative use of mass timber-hybrid structural, flooring and balcony systems in tall multi-family housing. Construction will target Passive House certification to meet carbon emission goals.

▲ **First Nations Health Authority ($500,000):** This six-storey building will demonstrate institutional use of mass timber supporting health and cultural activities. The design will expose as much mass timber as possible to evoke the plank house tradition of the Coast Salish people; space will be used for First Nations Health Authority employees, as well as social spaces for gatherings, cultural activities and education. The building will target Rick Hansen Foundation certification for accessibility.

- **Canadian Wood Council, GHL Consultants, CHM Fire Consultants ($300,000):** Mass timber demonstration fire tests will be used to educate key stakeholders about the performance of mass timber construction. Test data will support future code change proposals and new fire suppression systems. Cost is shared with Natural Resources Canada, National Research Canada and other provincial governments. Lessons learned will be shared with other jurisdictions in Canada.

- **Fast + Epp, GHL Consultants ($92,000):** This research project will assess the transferability of international tall wood building codes to B.C. and Canada to advance the next-generation use of wood in buildings.

- **Morrison Hershfield ($105,000):** The proponents will develop costing data on mass timber construction for wide use by developers, builders and other decision-makers. This will be especially pertinent as the B.C. Energy Step Code becomes more widely used to increase energy efficiency and meet CleanBC goals.

Westbank ($500,000): This 21-storey rental building will demonstrate mass timber-steel-concrete use in a tall building. The project will demonstrate cost-effective design solutions using materials for their highest value. Learning from the project will be shared as open source. The developers are aiming for the City of Vancouver's Zero Emissions Building Plan standard.

Faction Projects ($137,000): This four-storey hybrid mixed-use building will demonstrate the feasibility of local trades, rather than factories, to produce mass timber panels. Local mass timber panel production using available suppliers and trades will create local jobs and reduce supply-stream risks. This project also will be used to educate the insurance and lending industry on mass timber to reduce premiums associated with mass timber buildings. Developers will pursue Step Three of the B.C. Energy Step Code, the highest level for buildings of this type in the region.

- **Athena Sustainable Materials Institute ($70,000):** Lifecycle assessment research will demonstrate the carbon benefits of mass timber use and encourage wider adoption by building designers, policymakers and other decision-makers.

More information about these projects is available at: naturallywood.com.

MORE PROJECTS IN CANADA

- The McGill University School of Architecture will be constructing a $19-million, 18,000-sq.ft., mass timber multidisciplinary research center, the **Building Architecture Research Node (BARN)**, in Sainte-Anne-de-Bellevue, Quebec. The new structure will be the home base for McGill's DeCarbonized Architecture and Building (DeCARB) research group. Federal and provincial funding is providing approximately $16 million towards the project.

- In Vancouver, **T3 Mount Pleasant** will be the tallest mass timber office building in Western Canada, at 10 storeys tall. The 196,000-sq.ft. building is being designed according to Hines' proprietary T3 system which combines timber, transit and technology. Construction is planned to begin next year, with completion in 2024.

UNITED STATES

- The University of Washington is currently building **Founders Hall,** a $75-million, 85,500-sq.ft. mass timber facility for the Foster School of Business, on track to be completed next year. The structure, designed by LMN Architects, is targeting LEED Gold certification.

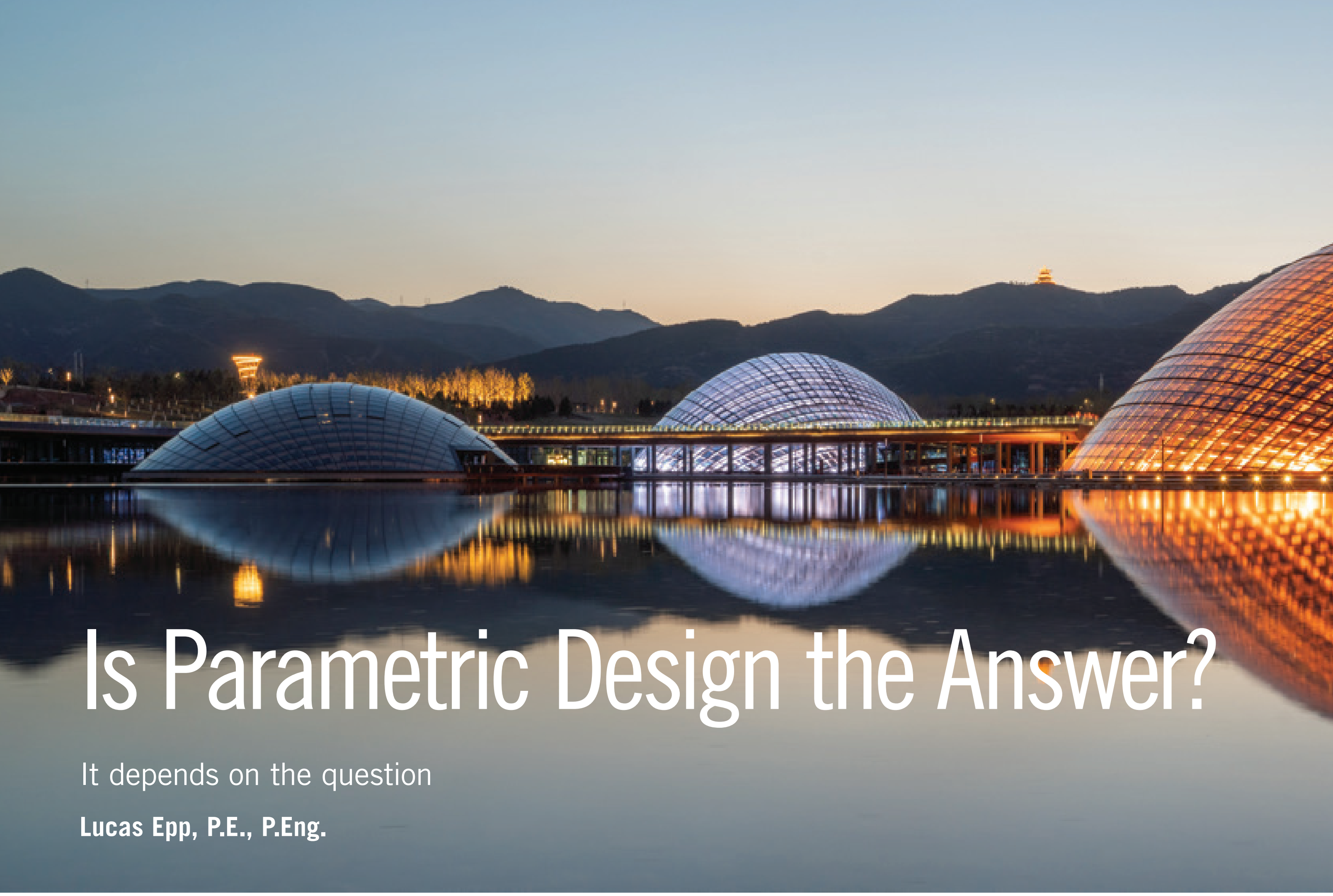
- Also in Washington, construction is set to begin for the $73-million **Darrington Wood Innovation Center**, which will include a mass timber production facility, with plans for completion in 2023.

INTERNATIONAL

- After winning a design competition, Norway's Mad Arkitekter is set to build what will become Europe's tallest wooden building in Berlin. The 322-ft.-tall, 29-storey mixed-use **WoHo** tower (consisting of four individual volumes) will feature 25 percent commercial spaces, affordable housing and amenities such as a daycare area, workshop and electric car charging stations.

- Mitsui Fudosan and Takenaka Corporation are planning to build the **tallest wooden building in Japan**, a 17-storey office tower in Tokyo's Nihonbashi district. Construction is scheduled to begin in 2023.

For more about upcoming projects and other industry news, be sure to sign up for the e-newsletter at WoodDesignandBuilding.com.



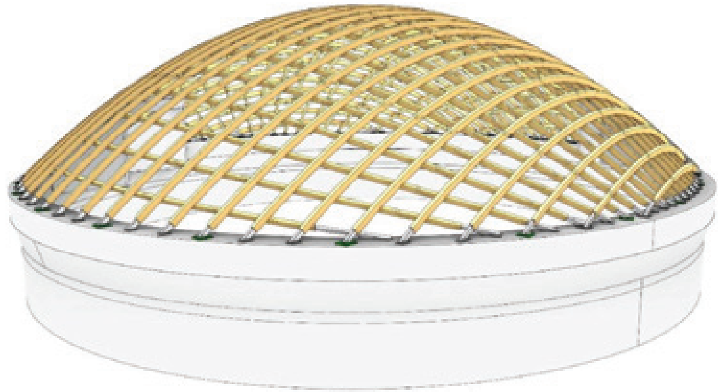
Is Parametric Design the Answer?

It depends on the question

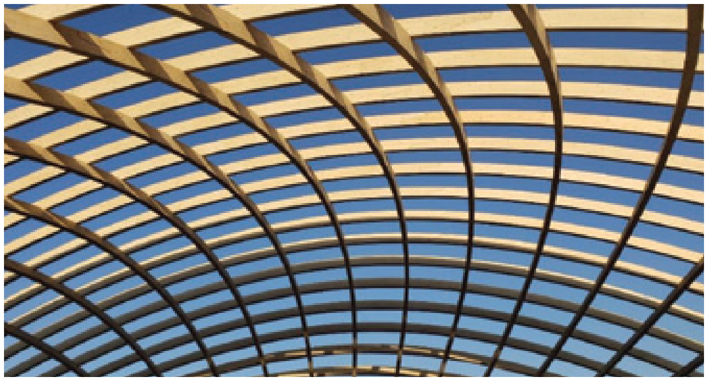
Lucas Epp, P.E., P.Eng.

Three dramatic timber gridshells with clear spans up to 300 ft. at the recently opened Taiyuan Botanical Garden in Taiyuan, China.

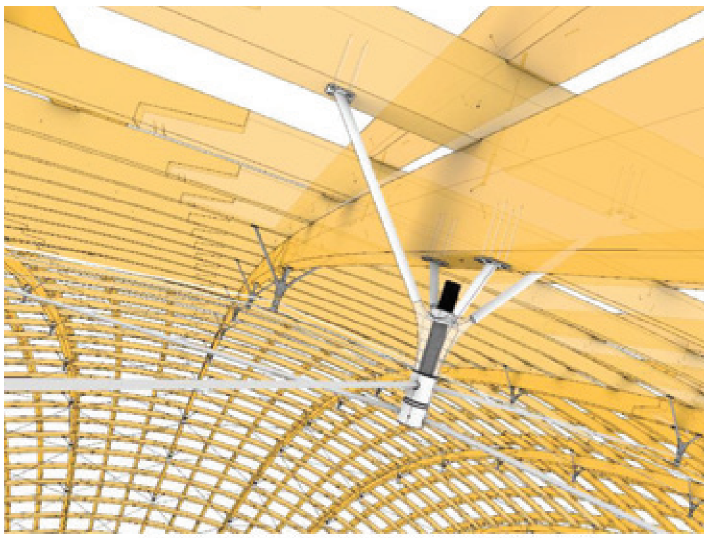
A new era of timber architecture has arrived. From taller wood buildings to customized freeforms, use of timber as a construction material is driving change in the way we design, manufacture and construct buildings. Across all building types, mass timber is proving to be a viable new material. Mass timber production lines enable efficient "Batch Size One" manufacturing, allowing for mass customization perhaps more readily than other materials. Each glulam or CLT piece can be unique without adding complexity or significant extra cost to the manufacturing process. This CNC manufacturing process also creates an inbuilt instruction set for assembly, reducing time and required skill on construction sites, and



Fabrication level-of-detail 3D model.



A slender two-way glulam gridshell with completely hidden connections.



Cast stainless-steel node connecting cable diagrid to glulam gridshell above. The unique idea: tightening the nut pulls the cables closer to the glulam above, and actually tensions the cable net.

moving more construction to an indoor, robot-controlled environment.

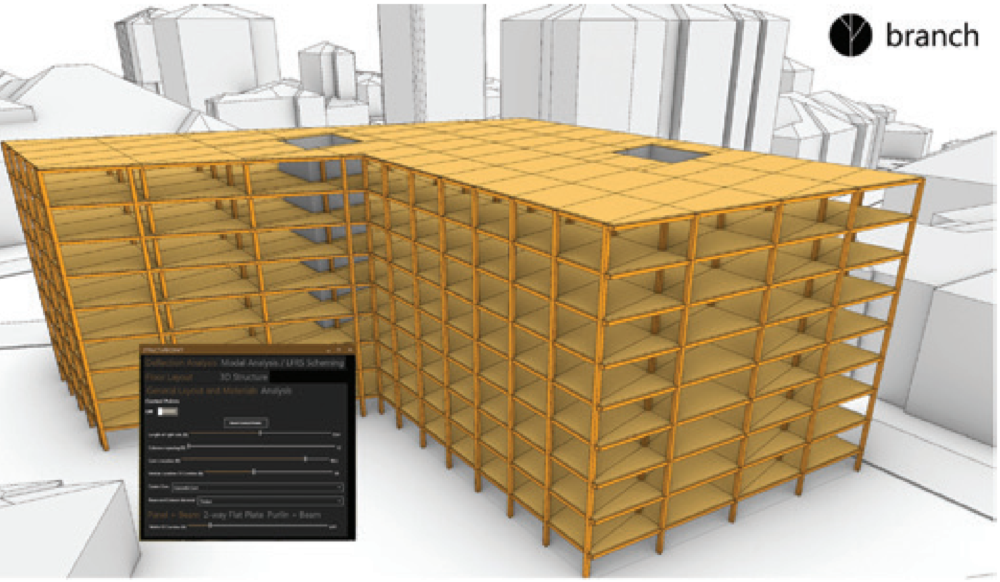
But what is next for mass timber? The mass timber revolution is not just a simple material switch from steel and concrete to timber. It is helping to instigate a wholesale change in the design and construction process.

Countless studies on construction efficiency have shown that current processes for constructing buildings are fundamentally flawed. Over the past 50 years, efficiency on construction sites has declined, not increased – a stark contrast to other industries. Attempts to address this often have focused on standardizing building design, removing design flexibility and increasing repetition – thereby limiting product choice to specific manufacturers' proprietary systems.

This natural tendency to productize parallels the approach taken by the automotive and aerospace industries – but perhaps a building is more akin to a software program than it is to a car or a plane. It is a complex fabrication which often takes years to design and construct, with information interfaces between designers, builders and operators, a myriad different end uses, and jurisdictions with widely varying functional and performance requirements.

Modern methods of construction provide techniques purported to address this issue of construction efficiency. Modular construction in its current form provides answers for certain building types, but leaves a large proportion of buildings unaddressed. Manufacturers' systems often limit creativity and only provide region-specific solutions.

The question must be asked. Will robots, AI, 3D printing or prefab as individual technologies create the increase in efficiency our industry needs, or does the real problem lie in the traditional design and procurement processes?



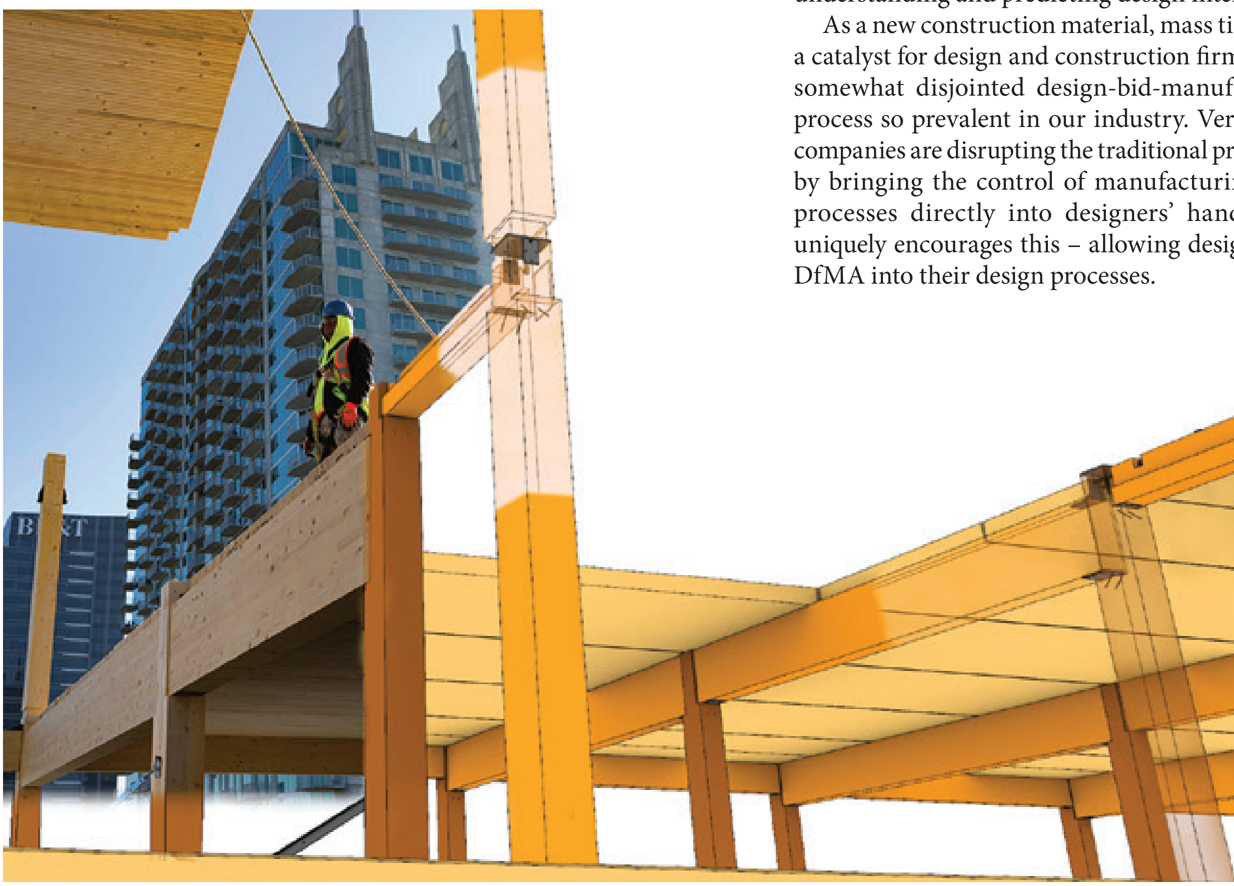
Branch, a new software platform, provides real-time structural analysis and manufacturing/assembly feedback to designers, connecting the entirety of the design-manufacture-assemble process. Analysis, design, connection detailing, CNC file generation, logistics, and assembly are incorporated into a single Rhino-based platform, enabling direct integration with the site and building performance analysis tools readily available within the Rhino ecosystem.

A NEW APPROACH

The AEC industry can no longer afford the time and cost of resolving the complexity of building in a process where designers are disconnected from construction. Unlike other industries, where the end result is a product into which years and copious amounts of R&D money can be poured, the building industry requires a more flexible and responsive solution. What is needed is an industry-wide change in the design and procurement process – a reconnection of design to both manufacturing and construction.

With the BIM revolution, the focus has been on the M: modeling. and creating digital "twins" that are accurate and highly detailed models and drawings which represent the design. However, our building industry does not need increasingly more detailed 3D models. It needs smarter software – that knows how to design, for manufacture and assembly (DfMA). This next generation of design software is not about product catalogues: it is about understanding and predicting design intent.

As a new construction material, mass timber has become a catalyst for design and construction firms to question the somewhat disjointed design-bid-manufacture-construct process so prevalent in our industry. Vertically integrated companies are disrupting the traditional procurement model by bringing the control of manufacturing and assembly processes directly into designers' hands. Mass timber uniquely encourages this – allowing designers to integrate DfMA into their design processes.



A direct connection between engineering, mass timber fabrication models, and the actual construction process is critical to enabling efficiency.

Designers, as a result, will embed the manufacturing and assembly process into their designs. Material availability, milling processes, shipping and prefab techniques suddenly become design mandates, not peripheral considerations talked about briefly and then left for "post-tender."

With DfMA constraints embedded into design software, more rapid customization and design exploration can be performed on projects without significant cost and schedule implications. This new paradigm will be enabled by the advent of design software which takes this thinking out of the realm of specific companies and brings it to the wider design community.

Mass timber as the newest (and perhaps oldest) building material is central to this revolution in the building design process. Its ability to enable mass customization is driving a new breed of design software, design processes and delivery models across our industry.

Design – not manufacturing processes, robots or drones – is the key to creating efficiency in the AEC industry. The next challenge is creating design software and tools which are both manufacturing- and construction-aware, led by vertically integrated companies focused on enabling real-time data flow between all stakeholders, whether designers, machinists or foremen.

What we have been trying to do for the past 23 years is bring design back into construction. Perhaps our industry will move back to the master-builder paradigm from where it originated. Back to a place where architects and engineers are also builders. Back to the future.

Lucas Epp is vice president and head of engineering at StructureCraft. He can be reached at lepp@structurecraft.com or 604.940.8889.

Mass timber flying at T3 West Midtown, a 220,000-sq.ft. office building in Atlanta for the developer Hines.

CASE STUDY: Taiyuan Botanical Garden

Lucas Epp, P.E., P.Eng.

The Taiyuan Botanical Garden, located in the capital of China's Shanxi province, features an artificial landscape that combines nature and architecture in a unique destination for local and international visitors. The Greenhouse is the centerpiece, featuring three biodomes that enclose flora from tropical, desert and aquatic biomes. The dome structures range 140–300 ft. in diameter and 40–100 ft. in height. The largest of the three domes is believed to be the longest clear-span timber gridshell (non-triangulated) worldwide. It is also likely the largest timber gridshell to be covered entirely in doubly curved glass, adding significant challenges to the structural design, which is in a region with significant seismic hazard. All three parabolic gridshells comprise light doubly curved glulam beams, arranged in two or three crossing layers.

The project pushes the boundaries of structural engineering, materiality and construction technique in a country that has little experience using timber for long-span applications. The use of a unique, optimized geodesic grid allowed minimization of doubly curved glulam, and enabled a manufacturing pace which could keep up with an intense Chinese construction schedule.

When viewed from above, the timber structures resemble seashells, with the primary members tightly spaced on one side and fanned out across the surface of the domes, driven by a desire to optimize solar gains by creating a gradient in skin transparency. This complex arrangement means that every one of the 2,400 glulam members is unique, many of which are doubly curved. Wood facilitated this "seashell" look in a more natural way than other structural materials could.

Computational design methods inside Rhino and Grasshopper were used extensively from concept design through to fabrication geometry and automatic generation of CNC machine files. This structurally optimized geometry was developed while looking at all constraints, including shipping/containerization, fabrication and pre-assembly, with kit-of-parts erection and sequencing drawings for site crews.

The unique seashell aesthetic on these domes required a two-way grid. This requirement created the project's single biggest challenge: achieving an efficient timber gridshell with elements which were moment-fixed to each

other, but with completely hidden connections. The connections used between the layers of the shell developed composite action between the top and bottom parallel layers, as well as rotational stiffness between the orthogonal layers. This rotational stiffness was critical to prevent in-plane shear buckling failure modes. Connection concepts using fully threaded screws were tested to failure at full scale both in-house at StuctureCraft and at Tongji University to establish strength and stiffness of the connections. These values were then input back into analysis models to allow accurate prediction of buckling and seismic performance.

The orientation of the beams was optimized to limit the amount of milling that was required, while still achieving the doubly curved shell geometry envisioned by the project architects. The curved timber beams, produced by two different European glulam manufacturers, were then packed together in shipping containers using an algorithm to organize in the order that they would be needed for site assembly in China.

The beam crossing elements were notched to fit tightly together, and pre-drill hole locations were mapped in Grasshopper, then drilled by CNC so workers on site could install approximately 60,000 screws in the required locations. At the junction with the ground, the timber beams connect to steel assemblies that are welded to embed plates cast into the concrete. All beams approach the ground at different angles, so each steel component is unique but generated from a simple set of parametric rules. The prefabricated panels ranged from 20–30 ft. wide and 30–40 ft. long. These were preassembled adjacent to the domes and craned into place onto temporary scaffolding, whose geometry was prescribed in the erection drawings.

The delivery of the design and manufacture of this structure in less than 1.5 years was made possible only by combining a unique, vertically integrated team of structural engineers. Use of extensive computational geometry and analysis tools, along with a bespoke software system to enable straight-to-fabrication from Rhino, was central to enable the digital fabrication and construction processes used throughout this project. The result is a world-class attraction, created through the efficient cooperation of team members on three continents.

ARCHITECT
Delugan Meissl Associated Architects
Vienna, Austria

STRUCTURAL ENGINEER
+ TIMBER CONSTRUCTION
StructureCraft
Vancouver, BC

LOCAL DESIGN INSTITUTE
Institute of Shanghai Architectural Design & Research
Shanghai, China

FACADE/INITIAL STRUCTURAL CONCEPT
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Vienna, Austria

PHOTOGRAPHY
CreatAR, Shanghai; Light Chaser, Taiyuan

For the expanded case study, including an image gallery, visit WoodDesignandBuilding.com.

JURORS

Anne Schopf
Partner
Mahlum
mahlum.com

John Newman
Director
Snøhetta
snohetta.com

David Edmunds
Partner
GEC Architecture
gecarchitecture.com

2020 *Wood Design & Building* Award Winners

Much like 2020, this has been a year unlike any other, and as most events became virtual due to the ongoing pandemic, the annual awards were postponed and held in early spring via video conference. Luckily, the awards entry platform has been cloud-based for several years, so the transition was relatively seamless. Although the staff and jurors missed the opportunity to connect in person, the daylong session was just as engaging and animated as ever.

Each year a three-person jury independently reviews the submissions, and on the final day of judging, the entries with the highest scores are discussed and reviewed by the group. This year we welcomed Anne Schopf, partner at Mahlum; John Newman, director and senior architect at Snøhetta; and David Edmunds, partner at GEC Architecture. Each jury has a unique perspective on architecture, and this year, most decisions were resolved without considerable debate. Those projects chosen as the winners were selected definitively, with unanimous enthusiasm.

The selection of the Honor winners is always fascinating because what might strike someone as a grand design is not necessarily what catches the attention of the jury. Creativity and unique applications, along with balance and elegance, consistently rise to the top – as demonstrated by the three projects chosen for 2020. A small library in China nestled against a natural rock wall, an outdoor recreation rink in Quebec and a multipurpose barn in Arkansas might not sound like award-winning ideas, but all three jurors were struck by the beautiful execution and striking impact of these structures. As Schopf commented, “Simple and elegant is really, really hard to do.” Each project shows the versatility of working with wood, and perhaps not coincidentally, all three Honor winners create environments that encourage a communal experience.

This year, we also expanded the magazine awards coverage to include more detail about the Merit, Citation and sponsored awards, because in many cases, these are structures that narrowly missed the top category. Seven countries are represented, with 16 winners from Canada and 10 from the U.S. Among the winners, Perkins&Will, Marlon Blackwell Architects, LUO Studio, Brook McIlroy, 1x1 architecture and Michael Green Architecture each claimed two awards.

In partnership with the Canadian Wood Council, we would like to thank everyone who participated in the 2020 *Wood Design & Building* Awards program, with special thanks to our three jurors and the program’s sponsors. Congratulations to the winners!

Zheshui Natural Library

Zheshui Village, Shanxi Province, China

A wood structure integrates elegantly into its natural setting

In northern China, the Zheshui Natural Library is named for the way it blends into its site between a rock cliff and a canal. The 525-sq.ft. library is nestled next to the rocks, using them for two sides of the library and for seating. The wood shelves opposite the rocks hold books while also supporting the sloping, wood-framed roof.

All of the timber is lightweight, minimizing the foundations and disruptions to the landscape. The library is enclosed by glass, with windows on the short ends and glass bricks across the long elevation facing the canal. The “naturalness” of the library is enhanced by a large tree that punctures the roof by the entrance.

The library reflects the village, which is closely articulated by the topography; many houses are built by leaning on the mountain. The Natural Library is inspired by this traditional construction method, with the “bookshelf” providing three functions: column-grid structure, a place to sit and, of course, shelves for the books. Light foundations were installed with minimal damage to the land.

Each component is connected to form a stable structural system. The gaps between the columns are filled with glass bricks, creating both an internal and external partition while supporting the building. The roof is assembled with two layers of panels, one layer laid horizontally and the other laid longitudinally. All the components work together to form the structural system, which is especially elegant in its simplicity.

ARCHITECT
LUO Studio
Beijing, China

STRUCTURAL ENGINEER
Yuejie Luo
Beijing, China

GENERAL CONTRACTOR
Shangmuzao Building Technique Co., Ltd.
Beijing, China

PHOTOGRAPHY
Weiqi Jin
Beijing, China

Patinoire du Parc des Saphirs

Boischatel, QC

A surprisingly expansive wood roof enhances this community space

Situated on a former Hydro-Quebec easement on the outskirts of Quebec's capital region, this project is part of an urban park on the edge of the Royal Québec Golf Club. The new roof structure aims to provide a protected playground that can be used as an ice rink in winter and doubles as a ball hockey or basketball court in summer.

The strategic use of wood is the project's greatest innovation. The design of the rink's roof was the hardest challenge, using a combination of glulam and steel to increase span without breaking the budget. The objective was to give an impression of lightness while exploiting the full potential of wood. Several iterations were developed to optimize the structure and achieve the most efficient concept. The adaptability expected for this building prompted the team to develop a project that could accommodate both winter and summer sports, while ensuring maximum utility of the service building.

The glulam structure in tandem with the steel tensioning system permits a free span of 28 meters, despite the relative thinness of the members. The geometry of the structure allows drainage on both sides of the roof, facilitating rainwater management. This large wooden veil rests on a steel colonnade extending on both sides of the playing surface. Without any additional elements, the bracing of the entire roof structure is integrated within the steel support system.

The unique shape of the roof is intrinsically innovative. The main trusses' variable girths are sized to minimize wood volume across the structure. Each truss is constructed using two identical pieces of wood assembled to conceal the connections between the trusses, tie rods and columns. Dozens of hidden connectors are needed to connect the trusses and columns. Angled in two different directions, columns are supported halfway between two trusses. The columns are off-kilter in all directions, yielding breathtaking results.

The service building functions as a garage for ice rink maintenance equipment and houses a visitor reception area, which is a common room for various activities including rentals. The service building is fully supported by a light timber frame structure and covered with spruce siding that marks its relationship to the large roof. It closes off the northeastern facade, shielding the playing surface from prevailing winter winds. Marrying function with elegance, this facility provides shelter while enhancing the outdoor experience.

CLIENT
Ville de Boischatel
Boischatel, QC

ARCHITECT
ABCP architecture
Quebec City, QC

STRUCTURAL ENGINEER
L2C Experts
Montreal, QC

TIMBER SUPPLIER
Art Massif
Saint-Jean-Port-Joli, QC

PHOTOGRAPHY
Stéphane Groleau
Montreal, QC

Thaden School Bike Barn

Bentonville, AR

Wood transforms a utilitarian facility into an inspirational space

The Thaden School is an independent junior and secondary school that combines academic excellence with "learning by doing" via three signature programs: Wheels, Meals and Reels. Through its partnerships with nearby community organizations, the school provides students with learning opportunities on and off campus, both indoors and out.

Sitting atop a berm on the eastern edge of the campus, the Bike Barn transfigures the vernacular of the region into an athletic facility housing a multi-use activity space, bike storage and support facilities. The 6,700-sq.ft. structure starts with the profile and space of a gambrel barn (made prolific in the region for its increased vertical storage capacity) and reconfigures it to create maximum flexibility for volleyball, basketball, cycling and more, with the spring point of the gable set to provide the most vertical clearance before the trusses begin.

Working with a local truss manufacturer, the truss was examined at an elemental level and its logic rethought in the creation of a bold figure attuned to its new purpose. In instances where structural steel was needed, light-gauge flitch plates were used as a continuation of regional building practices in favor of introducing other structural profiles foreign to the local timber construction culture.

Akin to a barn raising, 12 trusses were hoisted into place above dimensional wood columns with steel flitch plates, revealing the profile of a modified gambrel barn carved into the space of the interior. Set over a copper insect screen, the entire exterior is clad in a combination of red-painted and clear-finished open-joint cypress, articulating the body of the barn and where it is carved away on the west, forming a porch. Oriented towards the soccer field, this west porch provides an elevated, sheltered area for spectators.

With the exception of the storage and locker room volume, the entire space is naturally ventilated through open-joint cypress board siding, vented skylights and

a series of roller doors that can open the barn to the surrounding landscape.

The Bike Barn taps into an expanding cycling culture in the region and is integrated into a network of pedestrian pathways and a larger system of trails that extend throughout Northwest Arkansas. As the largest producer of timber in the American South, historically Arkansas has been an extractive state, where its timber is harvested and then shipped to be used elsewhere. In contrast to the idea of extraction, the Bike Barn explores the specificities of locality and the material culture of timber in the state.

Continued on p.28

ARCHITECT
Marlon Blackwell Architects
Fayetteville, AR

STRUCTURAL ENGINEER
Engineering Consultants Inc.
Lowell, AR

GENERAL CONTRACTOR
Crossland Construction Company, Inc.
Columbus, KS

PHOTOGRAPHY
Timothy Hursley
Little Rock, AR

IMAGE: 1x1 architecture inc.

Bar U Ranch Work Horse Barn

In Longview, Alberta, the Bar U Ranch National Historic Site of Canada is home to the largest collection of historical ranch buildings in Canada. This project entailed rehabilitating the Work Horse Barn, a Classified Federal Heritage Building. The 2,745-sq.ft. structure features exposed log walls, wood board ceilings and wood flooring with exposed aggregate concrete slab. The project included repair and replacement of exterior wood siding, interior structural reinforcement and bracing, and the reinstatement of the Bar U Ranch brand on the wood roof shingles. Preservation of existing materials was accomplished with gentle cleaning and a new application of linseed oil paint finishes on the exterior, completed this spring.

ARCHITECT
1x1 architecture inc.
Winnipeg, MB

STRUCTURAL ENGINEER
Heritage Conservation Services, PSPC
Ottawa, ON

GENERAL CONTRACTOR
Nitro Construction
Lethbridge, AB

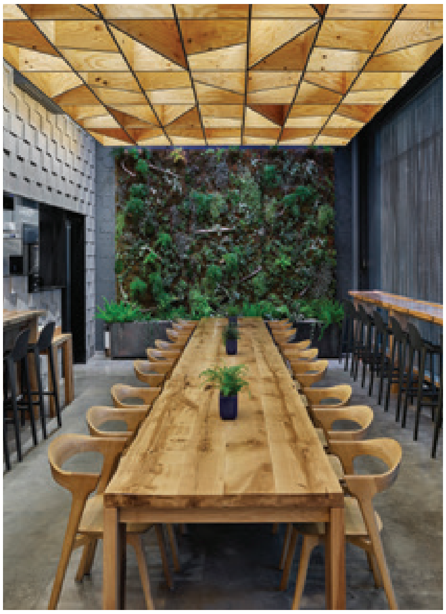

IMAGE: Timothy Hursley

CO-OP Ramen

The ceiling, seating and booths of this restaurant in Bentonville, Arkansas, are made from simple, construction-quality plywood, enhanced through careful joinery and detailing. This unique 3,354-sq.ft. building, with a dining area of only 1,500 sq.ft., now has a remarkable variety of spaces that remain unified by the design and material palette. Sheets of Douglas fir plywood start as the point of departure for the organizing cells of the ceiling; the sheets were subdivided and optimized to create multiple cells per sheet. The restaurant interior is organized by a rectangular grid of 2-ft.-10-in. by 3-ft.-10-in. modules that introduce a consistent rhythm throughout.

ARCHITECT
Marlon Blackwell Architects
Fayetteville, AR

STRUCTURAL ENGINEER
Gore 227 Inc.
Pea Ridge, AR

GENERAL CONTRACTOR
Heart + Soule Builders LLC
Bentonville, AR

IMAGE: Jesse Kuroiwa

Cottonwood Cabins

Located just outside Thoreau, New Mexico, Cottonwood Gulch Expeditions built six cabins, each 500 sq.ft., which includes a 100-sq.ft. deck with two cabin spaces on each side. This project – part of a 19-week Master's of Architecture design-build program – represented an investigation into alternative mass timber assembly methods. Standard lumber is replaced with 3x6-in. tongue-and-groove timbers, while swapping nails for engineered screws. The assembly eliminates the use of glue to achieve solid floors, walls and ceilings, allowing exposure to the exterior elements. The walls were assembled on-site, eliminating the need for cranes, which were unusable given the inaccessibility of the area. Doors are mounted on sliding tracks and conceived as movable walls, while large glazing areas allow the interiors to be flooded by light.

ARCHITECT
Students from the ColoradoBuildingWorkshop at the University of Colorado, Denver; faculty: Rick Sommerfeld, Will Koning and JD Signom
Denver, CO

STRUCTURAL ENGINEER
Andy Paddock
Colorado Springs, CO

IMAGE: Doublespace Photography

Horizon Neighborhood

Horizon is the first pre-designed neighborhood to be built at 9,000 ft. elevation on Powder Mountain, in Utah. The 30 wood-clad cabins range in size from 1,000–3,000 sq.ft. The cabins are aggregated around courtyards that maximize both community and privacy. Interestingly, cabins are accessed on the second floor via steel bridges due to the extremely high annual snowfall. The siting of the buildings and bridges was organized carefully to minimize views into neighboring units, while framing unobstructed, sunset views. Passive solar orientation is combined with thermal mass concrete floors and hydronic in-floor heating, while protected courtyards create "micro-climates" in an otherwise open, windswept landscape. The neighborhood will allow the majority of Powder Mountain's 11,500 acres to remain undeveloped and conserved for future generations. Important design considerations included following strict codes dictating building assemblies that were non-combustible because of the prevalence of wildfires in the region.

ARCHITECT
MacKay-Lyons Sweetapple Architects
Halifax, NS

STRUCTURAL ENGINEER
Dynamic Structures
Provo, UT

GENERAL CONTRACTOR
Mountain Resort Builders
Park City, UT

IMAGE: Josh Partee

Oregon State University Forest Science Complex

In Corvallis, Oregon, this project encompasses two new mass timber buildings totaling 110,000 sq.ft., featuring the first use of CLT rocking shear walls in North America. The Roseburg Forest Products Atrium is shaped by towering two-storey Douglas fir columns, sourced locally and fabricated less than 500 miles from the site. The exterior is clad in Oregon red alder that has been modified through acetylation to increase dimensional stability and resist rot. The project design approach was created in collaboration with multiple groups, which meant that the buildings themselves were designed to be a living laboratory – something to interact with and to learn from. The Advanced Wood Products Laboratory (18,000 sq.ft.) provides dedicated research spaces for developing and testing leading-edge wood products and technologies.

ARCHITECT
Michael Green Architecture
Vancouver, BC

STRUCTURAL ENGINEER
Equilibrium Consulting Inc.
Vancouver, BC

GENERAL CONTRACTOR
Andersen Construction Company Inc.
Portland, OR

IMAGE: Weiqi Jin

Party and Public Service Center of Yuanheguan Village

In the Hubei province of China, the Yuanheguan Village committee office needed to be moved and reconstructed, so the architects recommended a neglected residential plot for the new site. Wooden structures were utilized to fit into the local context and the site's existing concrete columns and foundations were incorporated to maximize design efficiency. The architects focused on avoiding damage to the original structure and were able to effectively combine the new extension with the old construction. The 5,876-sq.ft. building provides a shared environment where community members can gather; except for the conference area, the finance room and two enclosed equipment rooms, all other spaces are open, with seating, reading and communication areas.

ARCHITECT
LUO Studio
Beijing, China

STRUCTURAL ENGINEER
Yuejie Luo
Beijing, China

GENERAL CONTRACTOR
Shangmuzao Building Technique Co., Ltd.
Beijing, China

IMAGE: Wood Research and Development

The Roger Bacon Bridge

Part of a three-lane vehicle highway, this 207-ft.-long bridge in Nappan, Nova Scotia, was designed by the engineer for the province's Transportation and Infrastructure Renewal Department. It is Canada's longest clear-span three-lane timber bridge, replacing a steel structure with a similar arch profile. The existing steel superstructure was removed due to structural concerns, but the timber pile substructure was able to be revitalized and used in the new design. An independent consultant determined that timber construction would be the best choice due to the lower economic impact, longevity, aesthetics and lightweight nature of the material. The Douglas fir elements were treated with copper naphthenate; pentachlorophenol is prohibited in Nova Scotia. To adhere to soffit height conditions, a composite timber deck network was engineered to support traffic loads (up to 62.5T) while maintaining a shallow depth. In addition, the bridge was designed with multiple piles that allow for replacement and redundancy within the design; this allows elements to be interchanged if required.

STRUCTURAL ENGINEER
Wood Research and Development
Lower Cape, NB

GENERAL CONTRACTOR
Timber Restoration Services
Moncton, NB

IMAGE: Andrew Latreille

SoLo

Atop a forested knoll overlooking the Soo Valley in B.C., this off-grid residential prototype demonstrates a unique approach to building in a remote environment. As the first structure built to establish a zero-emissions alpine community, SoLo was designed to express a performance-led aesthetic. Wood was chosen as the primary structural material, resulting in beyond-net-zero energy ratings and Passive House certification. An outer heavy timber frame acts as a shield to resist the weather, while the heavily insulated inner layer acts as the thermal barrier. An innovative structural solution eliminates the need for wood shear walls by introducing two tension-rod braced frames at each end; this allows the frames to collect the seismic loads from the roof and enables unobstructed views from the large feature window. Double-height glazing takes advantage of the valley's incredible views. Wood is exposed in its entirety throughout the home – a "temple to Douglas fir." (To read more about this project, see the Winter 2020–21 issue of *Wood Design & Building.*)

ARCHITECT
Perkins&Will
Vancouver, BC

STRUCTURAL ENGINEER
Glotman Simpson
Vancouver, BC

GENERAL CONTRACTOR
Durfeld Constructors
Whistler, BC

IMAGE: Vincent Leroux

Wooden Villa

The entry for this unique single-family home in Soulac Sur Mer, France, is directly into the 1,400-sq.ft. living space or into one of the five other rooms. Made of larch, concrete and steel, the structure makes the most of the four directions of north, east, south and west. The home's roof is made of 136 larch caissons and aligns symmetrically with the matching floor of 136 okoume wood panels. A scaffolding warehouse had to be installed on-site to shelter the construction; the level of precision required to build the roof did not allow for any humidity. As well, there are no screws and no apparent nails used in construction. The use of shadow joints offers a unique sense of fluidity both inside and outside the house.

ARCHITECT
Nicolas Dahan Architects
Paris, France

STRUCTURAL ENGINEER
Cesma
Madrid, Spain

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IMAGE: Cameron Campbell Integrated Studio

111 East Grand Ave.

This is the first DLT office building in the U.S. The four-storey, 65,000-sq.ft. structure offers three floors of commercial office space over street-level retail. After interviews with various suppliers, the design team decided to pursue DLT because of mass timber's lasting benefits, including carbon sequestration and biophilia, which contribute to occupant health and support a sustainable work environment. The structure utilizes 41,671 cu.ft. of timber, including Eastern spruce glulam, all of which sequesters 284 tons of carbon and 1,042 tons of CO_2. A "kit-of-parts" approach allowed the entire structure to be erected within a seven-week period. Black Zalmag panel rainscreens clad the east, north and west elevations, striking a complimentary contrast to the natural Accoya wood. (The Winter 2018-19 issue of *Wood Design & Building* features a technical case study about this project.)

ARCHITECT
Neumann Monson Architects
Des Moines, IA

STRUCTURAL ENGINEER
Engineer of record for timber superstructure: StructureCraft Builders; Base building engineer: Raker Rhodes Engineering
Abbotsford, BC; Des Moines, IA

GENERAL CONTRACTOR
Ryan Companies
Des Moines, IA

IMAGE: David Whittaker

Awen' Gathering Place

This 1,668-sq.ft. open-air pavilion is prominently sited on a naturalized hilltop in Collingwood's Harbourview Park which links the town to the waters of Georgian Bay. As a beacon along the the Ontario town's shoreline, the pavilion creates a symbolic gateway. Alaskan yellow cedar was selected for length, uniform color and resistance to rot and infestation. The wood also lent itself well to the machine-lathing fabrication technique used to form the poles which were hand-hewn to add texture and bring the fine grain of the wood to the foreground. Based on the teachings of renowned Saugeen First Nation educator, artist and poet, Dr. Duke Redbird, the pavilion is a sculptural representation of the food forest, linking each forest layer to one of the Seven Ancestor Teachings – an ancient lesson on the ethics of proper behavior and conduct, or "the good way of life."

ARCHITECT
Brook McIlroy Inc.
Winnipeg, MB

STRUCTURAL ENGINEER
Envision-Tatham Inc.
Collingwood, ON

GENERAL CONTRACTOR
Lafontaine IronWerks
Tiny, ON

IMAGE: Alan Tansey

Harbor Hideaway

Located in the village of Sag Harbor, New York, the 2,630-sq.ft. Harbor Hideaway is a single-family, two-storey residence. Although the instinct would be to design a house to face the street, the designers decided to flip the traditional orientation of the home to face the rear corner of the yard. The entire home utilizes a simple material palette of blackened steel, light hardwood and neutral colors. At the entry, the custom wood stair design connects the three interior levels of the home with a single gesture and provides a sense of openness that makes the home's modest footprint feel much larger. A black cedar facade wraps the entire home to naturally shade the south-facing bedrooms from the high summer sun and becomes a visual connection between the home and the carport, creating a covered entry in its path.

ARCHITECT
The Up Studio
Long Island City, NY

STRUCTURAL ENGINEER
Kevin Cieslukowski
San Diego, CA

IMAGE: Vantieghem Talebi

House of Cards

The geometry of this single-family home in Koksijde, Belgium, is reminiscent of historical beach house architecture in the area, characterized by steep roof angles. This style and the restrictions of the existing foundation steered the architectural logic of the project. At 3,175 sq.ft. gross area and 2,476 sq.ft. net area, the structure has an interesting backstory. Due to structural and zoning constraints, new construction is placed on top of an existing foundation and is limited to a maximum allowable height. As such, the design grew out of the foundation's asymmetrical cruciform geometry, where each structural bay created a "House of Cards." The project envelope is built as a timber rainscreen made of chemically seasoned Douglas fir battens. Considered a facade element due to the steep pitch, the roof is also built from the same technique. To streamline construction and avoid visible screws or nails in the timber battens, the battens were prefabricated.

ARCHITECT
Vantieghem Talebi
Los Angeles, CA

STRUCTURAL ENGINEER
Util Struktuurstudies
Brussels, Belgium

IMAGE: Ken Goshima

Light & Green Office

This project involved relocating an office from a suburb to the center of the city. With a goal of using locally sourced materials, Ezo pine, a native species of Hokkaido, was selected as the structural material. Employing the traditional Japanese construction method of "shinkabe" (a wall in which framing is set between pillars exposed on the interior side), a highly airtight and insulated two-storey 2,979-sq.ft. building was realized. Lumber remnants generated in the manufacturing process were used to make lattices in the exterior walls. Contact points were made smaller and the materials were divided in three layers to inhibit decay. Use of raw wood was maximized and wood surfaces were left unfinished as much as possible. In planning, the presence of marronnier trees next to the site was taken into account in determining the arrangement of the openings, and a reflection pool was installed to enhance the natural connection to the building's surroundings.

ARCHITECT
Endo Architectural Atelier Co., Ltd.
Hokkaido, Japan

STRUCTURAL ENGINEER
Kosaku Ando Structural
Planning Office Co.
Tokyo, Japan

GENERAL CONTRACTOR
Hiragata Komuten Co., Ltd.
Hokkaido, Japan

IMAGE: Luis Díaz Díaz

Lookout da Cova

Abadía da Cova Winery required an outdoor space where visitors could enjoy tasting their wines while contemplating the landscape. The architects added a 3,014-sq.ft. open-service area, including an indoor wine bar, bathroom, storage room area and a small wine-tasting room. To reflect the environmental values that identify Abadía da Cova, the architects wove in the interrelationship of the environment and surrounding landscape. Acetylated Scots pine from 28-year-old plantation trees achieves unparalleled levels of durability and stability; this avoided the use of finishes with biocides that could affect the surrounding vineyards. On the other hand, the decision not to resort to lamination processes meant that available timber sizes were limited and dimensions were reduced. Also, considering the exposure to wind forces, different strategies were implemented. The configuration of the porticos was solved by triangulating in such a way that all elements are, in general, only subject to axial efforts. The whole structure is anchored to the ground by means of a slab and reinforced concrete walls, providing the necessary rigidity. The outer side of the concrete walls is resolved with a formwork of wooden logs of varied diameters.

ARCHITECT
Arrokabe Arquitectos SLP
Santiago de Compostela, Spain

STRUCTURAL ENGINEER
Mecanismo Ingeniería
Madrid, Spain

GENERAL CONTRACTORS
Construcciones Joalpe SL;
José Vázquez Santos
(auxiliary building, wine bar carpenter)
Maceda, Spain; La Coruña, Spain

IMAGE: Tom Arban

Odeyto Indigenous Centre at Seneca College

Odeyto (the Anishinaabe word for "good journey") is the new 1,600-sq.ft. home for the First Peoples at Seneca College Newnham Campus in Toronto. Conceptually, the project was inspired by the image of a wood canoe pulling up to a dock – making a stop at Seneca College to gather knowledge before continuing on life's journey. As the only building on campus with an organic, curvilinear design, the "wood canoe" has a distinctive presence. One of the strongest cultural references is in the structure of the roof. Resembling the hull of an overturned wood canoe in both form and construction, it is supported by 28 Douglas fir glulam ribs supporting a tongue-and-groove Douglas fir deck. This species was selected for its warm color and its patina as it ages. The ribs were factory sanded and finished with Sansin SDF sealant to protect the wood, whereas the Douglas fir decking was left in its natural state.

ARCHITECTS
Gow Hastings Architects;
Two Row Architect
(Indigenous design)
Toronto, ON; Ohsweken, ON

STRUCTURAL ENGINEER
Read Jones Christoffersen Ltd.
Toronto, ON

GENERAL CONTRACTOR
Mettko
Toronto, ON

IMAGE: Ema Peter

Passive Ski Cabin

This project in B.C. involved constructing a unique, 3,800-sq.ft. home designed to optimize views of Mt. Begbie, Revelstoke's "most recognizable summit." A central courtyard was inspired by the owner's travels to Japan, where many residences have private courtyards. The client wanted a sustainable house, so the builders started by incorporating a main superstructure of CLT panels, with no interior constructed supporting frame. The exterior of the CLT is braced by timber angles and fully clad in 12-in. wood fiber insulation. The exterior cladding is cedar burnt in the style of shou sugi ban, the Japanese treatment of charring wood to make it weatherproof. The interior shows off the raw nature of the CLT timber walls.

ARCHITECT
STARK Architecture Ltd.
Mississauga, ON

STRUCTURAL ENGINEER
Woodall Structural Engineering Ltd.
Calgary, AB

GENERAL CONTRACTOR
Tree Construction
Revelstoke, BC

IMAGE: Ema Peter

Veil House

This 3,300-sq.ft. single-family home uses wood in an original, contemporary way. This project also strove to upcycle used wood as part of its sustainability goals. The architect utilized wood as a tool for cladding, turning the horizontal conventions of tongue-and-groove Western red cedar 90 degrees to create a vertical format, then wrapping the wood to the roof to achieve a monolithic wall treatment. A silver stain to the cedar was added to help expedite its patina and lower the maintenance footprint. This also served to achieve a timeless, "it's always been there" look.

ARCHITECT
Measured Architecture
Vancouver, BC

STRUCTURAL ENGINEER
Entuitive Corporation
Vancouver, BC

IMAGE: Andrew Latreille

Whistler Gateway Loop

In Whistler, B.C., the 6,000-sq.ft. canopy of the Whistler Gateway Loop creates a dramatic first impression for visitors arriving by highway coach. The design team developed a spruce-pine timber structure comprised of a triangular arrangement of glulam beams supporting CLT panels. To showcase the natural beauty of the engineered wood, the support systems were pared down; the number of columns was minimized, braces were eliminated and timber connections were concealed. The wood-on-steel structure creates a stiff yet light roof that can manage the demanding snow loads. The HSK system by Timber Composite Technology was chosen for its strength, stability and concealed adhesive connections. This use of the system is the most ambitious to date, according to its developers.

ARCHITECT
PUBLIC: Architecture + Communication
Vancouver, BC

STRUCTURAL ENGINEER
Fast + Epp
Vancouver, BC

GENERAL CONTRACTOR
B. Cusano Contracting
Surrey, BC

IMAGE: Scott Norsworthy

720 Yonge St.

The first commercial mass timber project to be built in Toronto integrates the character of the original heritage structure with new contemporary wings. The design employs innovative mass timber elements, most notably the all-wood, fire-rated elevator shafts and exit stairs, which reduced the need for poured concrete construction. The three-storey building features exposed wood elements consisting of Douglas fir/larch glulam columns and beams, in combination with spruce-pine-fir CLT floors, roof, core partitions, guard walls and shaft assemblies.

ARCHITECT
Brook McIlroy
Toronto, ON

HERITAGE CONSULTANT
ERA Architects
Toronto, ON

STRUCTURAL ENGINEER
Blackwell Structural Engineers
Waterloo, ON

GENERAL CONTRACTOR
JMC Building Developments
Concord, ON

IMAGE: Phil Bernard

Bromont Summit Chalet

Perched at the summit of Mont Brome in Quebec, this ski chalet was built with sustainable, local products and local craftsmanship. Its interior exposes natural, soft light and warm wood through an envelope of immaculate white, designed to frame the landscape. The wooden envelope takes on a structural role and forms an envelope of cedar, chosen for its natural appearance and ecological properties. Wooden strips of varying sizes allow for the integration of various lighting elements and a variety of textures, while creating a dialogue between the peripheral wooden structure and a strong wooden core, key to the project's structural design.

ARCHITECT
LEMAY
Toronto, ON

STRUCTURAL ENGINEER
ELEMA
Montreal, QC

GENERAL CONTRACTOR
DECAREL
Montreal, QC

IMAGE: Adrien Williams

Edmonton Valley Zoo Urban Farm

This 17,437-sq.ft. project facilitates an immersive visitor experience, thanks in part to its expressive and engaging heavy timber structure. The team worked closely with Beam Craft to refine the connection between heavy timber elements. Each connection detail was modeled in three dimensions, with the information from these "3D shop drawings" used to inform the milling of individual structural members. This integrated approach to fabrication greatly reduced the time required to erect the timber structure. The use of wood as a primary construction material connects traditional modes of construction with contemporary fabrication techniques and reinforces the zoo's commitment to sustainable design practices.

ARCHITECT
the marc boutin
architectural collaborative inc.
Calgary, AB

STRUCTURAL ENGINEER
Read Jones Christoffersen Ltd.
Edmonton, AB

GENERAL CONTRACTOR
Clark Builders
Edmonton, AB

IMAGE: Julian Parkinson

Green Gables Visitors Centre

In Cavendish, P.E.I., the site that inspired the *Anne of Green Gables* series is one of the most visited National Parks in Canada. At 12,809 sq.ft., this project was initiated to accommodate a growing number of visitors and add much-needed exhibition and gathering spaces, acting as the main arrival point. The architecture takes cues from the rural context through vernacular barn forms, connected by a single-storey lobby space, all employing a mass timber structural frame. Designed to achieve LEED Gold certification, the building uses locally sourced wood via exposed mass timber frames, Eastern white cedar shingles, local pine and thermal wood and maple for the interior spaces.

ARCHITECT
Root Architecture Inc.
Dartmouth, NS

STRUCTURAL ENGINEER
CBCL Ltd.
Halifax, NS

GENERAL CONTRACTOR
WM&M Contractors
Charlottetown, PEI

IMAGE: Shai Gil

Metrick Cottage and Boathouse

This is a one-storey, semi-charred (shou sugi ban) wood-clad residence and boathouse in Ontario. The residence consists of three distinct "pods" comprising four bedrooms, four baths and an open living area. The design challenge was to create a home using all-natural wood materials, transportable by boat to this remote location. Materials also had to be durable and able to withstand harsh seasonal climates without relying heavily on paints or stains. As a result, Douglas fir timbers, cedar and torrified ash were selected as the main materials. Visible structural components, including exposed roof rafters and scissor joists, are prefabricated Douglas fir. The hidden structural components used throughout were prefabricated wood TJI joists, wood wall structure framing and LVL beams.

ARCHITECT
Akb Architects
Toronto, ON

STRUCTURAL ENGINEER
Moses Structural Engineers
Toronto, ON

GENERAL CONTRACTOR
Mazenga North Building Group
North York, ON

IMAGE: Tom Arban

Toronto Montessori School Bayview Campus

This 22,292-sq.ft. addition includes an atrium, offices, double gym and related support areas. The semi-circular building wraps around a landscaped entry plaza, where a double-height atrium is supported by a tree-like wood structure made of Douglas fir. Three arches support the main load of the building. From the arches, a series of beams span across the triangular curtain walls and connect the perimetral columns. The beams form a mid-range fractal pattern, emulating the tree-like patterns. The main structure is finished with exposed wood beams and wood deck, giving the atrium a sense of warmth. A key aspect of the design was using as much natural light as possible. An entrance canopy made of wood and stone follows the building's footprint.

ARCHITECT
Farrow Partners Inc.
Toronto, ON

STRUCTURAL ENGINEERS
WSP Global Inc.; Timber Systems Ltd. (timber fabrication/ design assist)
Toronto, ON; Markham, ON

GENERAL CONTRACTOR
TriAxis Construction Ltd.
Mississauga, ON

IMAGE: Creative Sources Photography

T3 West Midtown

Currently the largest mass timber building in the U.S., T3 West Midtown is a 255,000-sq.ft. commercial development situated in Atlanta, Georgia. The client made wood the primary component of its T3 buildings because it is the only renewable structural material and offers advantages of aesthetics, energy efficiency, acoustics and light. T3 West Midtown is an amenity-rich, modern loft office concept that provides the character and warmth of late 1800s heavy timber buildings, with the advantages of modern, class-A construction. The layout features open floor plans with floor-to-ceiling windows, heavy timber columns, beams and concrete floors, with retail areas at the first level.

ARCHITECT
Hartshorne Plunkard Architecture; Architect of record: DLR Group
Chicago, IL

STRUCTURAL ENGINEER
Magnusson Klemencic Associates
Chicago, IL

GENERAL CONTRACTOR
New South Construction
Atlanta, GA

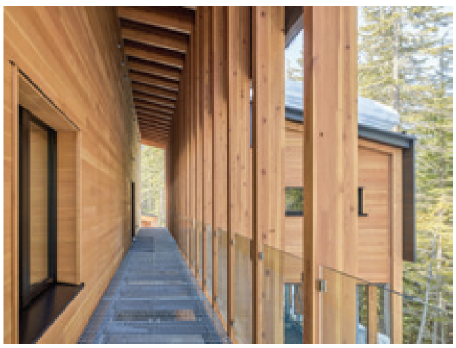


IMAGE: Andrew Latreille

The Merit award winner SoLo (above), by Perkins&Will, also received a CWC award.

SUSTAINABLE FORESTRY INITIATIVE – SPONSORSHIP AWARD

IMAGE: Christian Columbres

Robert Libke Public Safety Building

In Oregon City, Oregon, this building anchors a civic campus that celebrates history and provides enhanced amenities to the neighborhood. The building is constructed of mass timber – from the tall, vaulted roof of the multipurpose courtroom/council chambers to the interior shear walls. CLT gravity-bearing exterior walls support glulam girders, thereby eliminating perimeter columns, keeping the ceiling plane clean and highlighting the exposed CLT roof structure above. Rarely used juniper wood, sourced from eastern Oregon and located on the slats of the exterior benches, will develop a beautiful natural gray patina. The entire design creates a healthy working environment full of natural wood materials and daylight.

ARCHITECT
FFA Architecture and Interiors Inc.
Portland, OR

STRUCTURAL ENGINEER
KPFF Consulting Engineers
Portland, OR

GENERAL CONTRACTOR
P&C Construction
Portland, OR

WESTERN RED CEDAR – SPONSORSHIP AWARD

IMAGE: Lisa Stinner-Kun

Travis Price Centre, Camp Manitou

This year-round camp is located on 28 acres of land near Winnipeg. Envisioned as the centerpiece of the camp, the Travis Price Centre is a flexible, multi-use facility that includes a hall, commercial kitchen, dormitories, administrative offices and meeting rooms. The building's form consists of two adjacent gable-roofed volumes, offset in plan to provide views to the exterior and create outdoor spaces. The primary structure, including trusses, roof joists, load-bearing columns and walls, is constructed of wood. Shiplap cedar siding is utilized on soffits and walls at the entrances. Cedar also is used to highlight the exterior gathering area along the building's south facade and is prominently featured on the vaulted ceiling of the hall. Douglas fir veneer is used on all of the interior doors, while solid Douglas fir is used for interior and exterior benches. Lionply birch panels are used in the dorm rooms to provide a durable finish. Wood also is used for exterior elements, including the large pressure-treated deck and cedar fencing.

ARCHITECT
1x1 architecture inc.
Winnipeg, MB

STRUCTURAL ENGINEER
Crosier Kilgour & Partners Ltd.
Winnipeg, MB

GENERAL CONTRACTOR
Concord Projects Ltd.
Winnipeg, MB

Code-listed fasteners. Concrete-anchoring adhesives. Concealed connectors, brackets and splines. Simpson Strong-Tie® mass timber structural solutions give you maximum strength and design flexibility. With our team of expert engineers, ongoing technical support and a nationwide supply network that delivers exactly what you need, when you need it — you can be sure that your mass timber projects are stronger, faster and easier than ever.

To learn more about our innovative solutions, see our Connectors & Fasteners for Mass Timber Construction catalog at **strongtie.com/masstimber**.

SIMPSON
Strong-Tie

IMAGE: Benjamin Benschneider

SANSIN – SPONSORSHIP AWARD

Catalyst Building

Located in Spokane, Washington, the 164,800-sq.ft., five-storey Catalyst Building is the first office building in the state to be constructed of CLT. Featuring more than 140,000 cu.ft. of CLT, the building sequesters 4,093 tons of CO_2. The timber was sourced from local, sustainably managed forests and the panels were manufactured locally. Innovative prefabricated mass timber floor plates were developed to provide 30-ft. spans, using a ribbed panel system that combines CLT panels atop glulam "ribs" to provide the necessary strength and rigidity. Catalyst is pursuing Zero Energy and Zero Carbon certification, making it one of the largest buildings in North America to meet both standards. To help achieve this rating, the roof is covered with a 213 kW photovoltaic array. (The Winter 2020–21 issue features a case study about this innovative project.)

ARCHITECT
MGA | Michael Green Architecture; Architect of record: Katerra
Vancouver, BC; Seattle, WA

STRUCTURAL ENGINEER
KPFF Consulting Engineers
Portland, OR

GENERAL CONTRACTOR
Katerra
Seattle, WA

The Future of Wood: Parametric Building Platforms

How technology convergence enables consistent, yet infinitely configurable, mass timber

Oliver David Krieg and Oliver Lang

If design, engineering and manufacturing converge in a platform-based development process, the resulting building can be beautiful and functional, blurring the boundaries between mass production and uniqueness.

The construction industry has utilized the same time-consuming and costly process for decades. As a result, we are left with aging, unsustainable buildings that contribute to a significant percentage of global emissions. With the growing global demand for affordable housing, both industry leaders and city planners agree that change is needed to address the housing deficit with building solutions that are fast to construct, and less expensive to build and operate. Vancouver, for example, recently enacted the Greenest City Action Plan and the Climate Emergency Action Plan to work towards carbon neutrality.

This change is already on the horizon. While the Architecture, Engineering and Construction (AEC) industry is developing new technologies that can deliver buildings faster, more cost efficiently and with better performance, recent innovation in software and manufacturing automation now enables a departure from a fragmented service industry towards a product-oriented and platform-based approach for urban development. By combining the seemingly opposing ideas of repeatable and scalable production with new forms of highly configurable design, engineering and manufacturing solutions based on mass timber, this approach promises to provide breakthrough innovation to an industry that has been lacking productivity gains for over 75 years (see the World Economic Forum 2016 report: *Shaping the Future of Construction*).

Parametric design software enables the needed convergence of design engineering with systemized mass timber construction and automated prefabrication, towards this product-based approach. It offers infinitely configurable design from a highly adaptable platform, while ensuring process consistency, certification, building code and bylaw compliance, quality control

Modular construction doesn't have to look ugly: The seams between prefabricated mass timber panels are not visible after installation.

adaptable proprietary technology platform created to deliver highly desirable urban housing with a new level of affordability, longevity and environmental and social sustainability.

The promise of parametric design

Systematic construction and pre-fabrication doesn't have to be one-fits-all; it can be personalized for maximum urban livability and longevity. Parametric software fundamentally enables the interactions between product, building platforms and manufacturing.

Parametric, or generative, design is a process that encodes each design decision as a parameter, clearly defining the relationship between design input and output in the form of an algorithm. Through integration, the software not only can be used to sweet-spot building performance, cost efficiency and greenhouse gas emissions, but it also enables an interactive work environment to make well-informed decisions in increasingly complex stakeholder situations. There is an untapped potential for parametric design, particularly in combination with mass timber, to leave behind the formalism of the last decades and instead enable buildings that are low carbon, high performance and far more cost efficient. With parametric design, we can control and relate hundreds of input parameters and iterate through potentially thousands of design variations.

and predictability of building performance. As an example, Intelligent City offers one of the first fully integrated mass timber building systems platforms that combines parametric software development with advanced manufacturing automation, to deliver carbon-neutral building solutions that also offer a new cost-to-value paradigm. Parametric design enables buildings as repeatable one-stop products, and yet no building needs to look the same, while they can share 90 percent of their components and processes.

Intelligent City has been working for over a decade on this approach for deep technology and process integration. The company works with clients to design and construct sustainable, net-zero, multi-family urban green buildings, at lower costs for both owners, operators and tenants. Its system incorporates mass timber, design engineering, Passive House performance, automated manufacturing and parametric software. The company's Platforms for Life (P4L) model is a scalable and

Tailoring a building's overall shape and individual parts to context-specific requirements can result in time, money, energy and material savings.

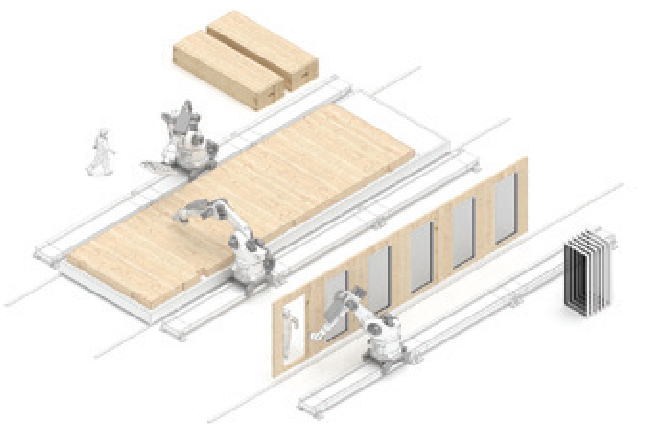
A notable, early example of a project that employed parametric design is Foster+Partners' roof of the Great Court in the British Museum. Built over 20 years ago, this project shows that unique, complex buildings can be designed and constructed with the help of algorithms that automate the generation of geometry and drawings. In the case of the British Museum's Great Court roof, optimization was one of the main goals: By digitally simulating the forces that the glass dome would experience in the real world, the shape of the dome was optimized for material efficiency. Under the umbrella of parametric design, the disciplines of architecture, engineering and materiality converged into a highly efficient development process.

Since then, there have been few examples where interdisciplinary parametric projects added real value such as

material savings, higher energy efficiency or the ever-elusive affordability. On the contrary, parametric design often has been reduced to creating architectural expressions.

At Intelligent City, parametric thinking has become an inherent aspect of the design process. On a fundamental level, design principles are developed not with single values but with a range of values. Decision making is not constrained by linear or hierarchical processes, but instead through the exploration of information from multiple perspectives in a nonlinear process. Among those are project objectives, different climate conditions, local site conditions, construction sequencing, building bylaws and, importantly, the broad range of tenant needs in their ever-evolving live/work environments.

Apartment types stored in a parametric library can be assigned to a building shape and can have their dimensions adjusted accordingly. Certain constraints influence how the apartment manifests within the available space, and available variations can be selected manually. If there is enough space, a studio apartment might get a storage space or a larger kitchen. Even at an early stage in a project, this process results in a lot of data for decision making, from construction cost to operational income. Proformas can be adapted readily to different building types, building form or varying the look and feel depending on contextual response or owners' branding needs.



Automated prefabrication means integrated design adaptability: by employing industrial robots at certain assembly steps, processes can be automated yet varied.

Incremental innovation is not enough

This concept is particularly powerful if the entire value chain of a building is incorporated. Once the underlying rules of building systems, materials and construction methods become part of a parametric design process, viable and buildable design variations can be achieved within seconds. If properly implemented, such parametric systems can generate fully detailed building information.

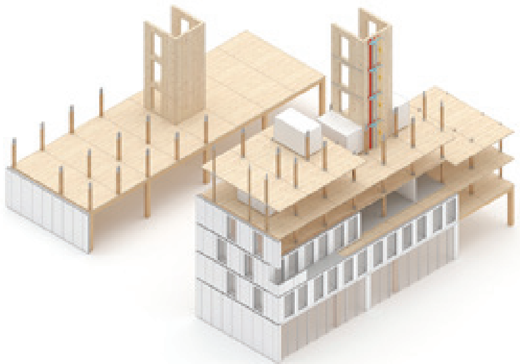
In our industry, such all-encompassing algorithms have made little sense in traditional building projects. In the early stages of design, an architect might have the most freedom but often little certainty about the construction materials and processes. In typical design-bid-build projects, the construction firm joins the project at a stage where their input often can impede the design instead of enabling a fruitful interdisciplinary environment. Why build complex algorithms that could automatically generate all building elements and construction details if the building system is unclear or could potentially change materiality at a later stage in the project? The investment in the development of such algorithms does not make sense for the traditional architect.

Some architecture firms with a high throughput of similar buildings have started to develop algorithms that support a certain subset of design problems that are common across multiple projects. Many firms have developed tools such as automated massing studies, energy performance studies or movement analyses for office spaces. While those algorithms can make design processes faster and result in better-functioning buildings, they do little in solving the true pain points of construction, because they are not directly tied in with information about construction, building systems and their materials or manufacturing processes.

Intelligent City is currently commissioning their robotic processes, which will process, assemble and fix mass timber elements within their floor panel and envelope panel components.

When design, engineering, materiality and construction converge within a vertically integrated company, buildings become products. Like a laptop, phone or car, the resulting design and quality of a building becomes as important as its manufacturing process. For buildings, however, the product should not embody a singular solution, but each iteration can be unique in its expression through the integration of parametric design principles.

One material has shown particular promise to accommodate such systemic change: mass timber. Although wood is one of the oldest building materials, it lends itself well to modern automation and prefabrication, which are both crucial aspects in this new product-based paradigm. Aside from its obvious sustainability and health benefits, wood is lightweight and can be machined easily and processed in a factory environment. In addition, mass timber can be used for high-rise construction and offers advantages for the automated production of large-scale building components.



Intelligent City's mass timber P4L building platform consists of adaptable floor cassette panels, high-performance envelope panels and other components, such as lateral cores, service shafts and accessories.

Parametric timber platforms

In other industries, the term "platform-based design" describes an integration-oriented approach for the development of complex products that share compatible hardware or software. This establishes a general knowledge base within a company on which variant forms of the same solution can be realized. It is also an inherently interdisciplinary process and requires constant exchange between experts in design, engineering, manufacturing and many other fields. One of the most prominent examples can be found in the car industry, where platforms are used to serve multiple car models.

In the context of the construction industry, a "parametric platform" describes a platform-based approach that is not defined by a fixed set of building elements and components, but by parameters; for example, a window can have a size ranging from 2x3 ft. to 6x8 ft., and anything in between. Its position within the envelope can be varied but is constrained by partition walls or building corners. In short, both the size and position of a window is variable.

For multi-story buildings, and housing in particular, many more aspects must be integrated when developing a parametric platform. Although it is a challenging task, there are scalable solutions available to us today.

At Intelligent City, we developed a parametric mass timber building platform for six- to 18-storey mixed-use urban housing compliant with new mass timber high-rise regulation in Canada and the U.S. This market segment was selected because of its potential for a healthy urban density between low-rise sprawl and high-rise concrete. At this height, mass timber buildings excel not only because of their structural performance and fire safety, but because they enable an urban typology that is dense enough for public infrastructure to be economically feasible, and low enough to promote resilient communities and connectedness.

The company's mass timber building platform consists of modular hollow-core floor panels with pre-installed integrated services, and high-performance, large-scale facade envelope panels that enable consistent high-performance Passive House certification. All building components were based on an interdisciplinary development approach at the heart. Starting with a clear set of design intentions, the team worked through mass timber construction details, prefabrication and manufacturing automation principles, logistics and supply chain issues. Considerations of structural requirements for different heights, seismic cores or service shafts became part of the development process. The team developed new production workflows using industrial robots to automatically assemble large building parts, allowing for a higher degree of adaptability, as well as assembly speed and quality. Intelligent City's automated factory will be ready to start production this summer.

The integration of the parametric design process, the building systems platform and the manufacturing automation enables a "design system" within which building variations can be explored and analyzed, optimized and cost out. Having advanced knowledge about all critical project data from the earliest stages of the design allows our clients to make highly informed decisions. The generation of a completely detailed virtual building from all data points, with clear manufacturing code and assembly instructions, is then only a click away. Parametric design allows us to "design and build smarter" and embrace the change that people and the industry demand.

This kind of integrated and parametric thinking enables scalability to reach various national and international markets. This is key for a new technology to take a foothold in our industry. While we respond to local needs, we must think globally. It is in the combination of an adaptable platform with a parametric software system and manufacturing automation that this can be achieved.

The AEC industry has been stuck in a dichotomy to provide services for bespoke one-off solutions while trying to de-risk through project management instead of integrated technology innovation. A shift from service to product, and from fragmentation to an integrated and variable mass timber platform that is pre-engineered, tested and certified, enables a path where aspirations for high-performance buildings, outstanding urban livability, affordability and carbon neutrality are no longer mutually exclusive. The key to this change lies in the combination of parametric design, manufacturing automation and mass timber. Through deep integration, these technologies have the potential to enable the breakthrough innovation which is long overdue in our industry.

About the authors:
Oliver Lang is the CEO and co-founder of Intelligent City, and Oliver David Krieg is the chief technology officer. Intelligent City is a technology-enabled urban housing company. The firm has been working on deep technology and process integration for over a decade, to design and construct sustainable, net-zero, multi-family urban buildings at lower costs for owners, operators and tenants. Its system incorporates mass timber, design engineering, Passive House performance, automated manufacturing and proprietary parametric software. The company calls this the Platforms for Life (P4L) model – a scalable and adaptable technology platform created to deliver highly desirable urban housing.

Preventing Acoustical Issues

How to manage flanking noise in mass timber buildings

Sarah Mackel, Aercoustics Engineering Ltd.

Open concept plan at the Catalyst Building IMAGE: Ben Benschneider

Once considered a buzz phrase, biophilic design has become an important part of architectural and interior design, perhaps even more so recently, as many have come to appreciate the impact nature has on our mental health and well-being. Derived from the Greek words for life and love, biophilia means a love of nature. It brings the outside world inside, integrating natural elements like plants and wood into the building interior. Examples include skylights, plants, green walls, healing gardens and wood finishes.

When wood is used as a structural element and there is a desire for increased amounts of exposed wood, it introduces significant acoustical challenges, particularly for secondary or indirect paths of noise transfer. Direct sound travels through floors, ceilings or walls and allows loud noises in one unit to be heard through a dividing wall. Indirect sound travels through structural elements, such as the floor, joists or shear walls, as well as ceiling cavities, pipe penetrations, junctions between floors and walls, and cracks. These secondary sound transmission paths are known as flanking paths, and wood buildings are more susceptible to noise issues due to the number of paths available for sound to travel, other than directly through the demising partition itself.

Flanking is an issue in all types of structures but more so in lightweight construction. For comparison, a typical mass timber floor is about 20–25 psf and a typical concrete floor is 80–100 psf. In heavy concrete construction, flanking noise starts to show up when designing for very high STC (sound transmission class) ratings (typically 65+). STC measures how effectively a wall, floor or ceiling can reduce the transmission of airborne sound between rooms. Generally, the higher the STC number, the less sound is transmitted. An STC rating as high as 65+ would be used in a facility like a recording studio where you don't want any sound transmission between adjacent spaces. The room within a room construction typically used for theatres, studios, and loud mechanical rooms is done to provide high STC ratings for these spaces and also reduce the flanking sound transmission by protecting the structural elements from noise generated in the room.

The exposed ceiling at the Catalyst Building showcases the building's wood structure IMAGE: Ben Benschneider

In lighter weight construction, flanking issues become prevalent at lower STC ratings which is why it can be more of an issue with mass timber. High STC ratings at the demising wall alone will not guarantee a high level of sound isolation because flanking noise is unaccounted for in STC tests for partitions that are determined in laboratories. ASTC (apparent sound transmission class) is a more realistic measure of the actual sound level transmitted between adjacent spaces in a building since it includes noise transmitted through walls, ceilings, and floor junctions. Leaving mass timber exposed compounds the issue by adding to the flanking paths. Exposed timber structural walls and ceilings reduce the ASTC rating and complicate the sound isolation design.

There are no requirements or building

code recommendations for sound transmission in commercial spaces. The industry standard is to provide approximately an STC rating of 50 for floor separations in commercial buildings, particularly a multi-tenant facility. Most residential codes in North America mandate a specific sound performance or STC rating for walls and floor systems. In the 2015 National Building Code, a strict requirement for ASTC ratings between units was added. Like with STC, a higher ASTC rating signifies the sound separation between units will be better. Adjacent units in a building must now be separated by a wall, floor, or ceiling partition with an ASTC rating of at least 47.

Achieving these ratings when working with an exposed mass timber wall or ceiling is more challenging and can be costly but not impossible to solve. If acoustical planning is part of the early design process with consideration of flanking paths and sound isolation, it is possible to minimize costs and enjoy the benefits of a mass timber building without compromising acoustic performance.

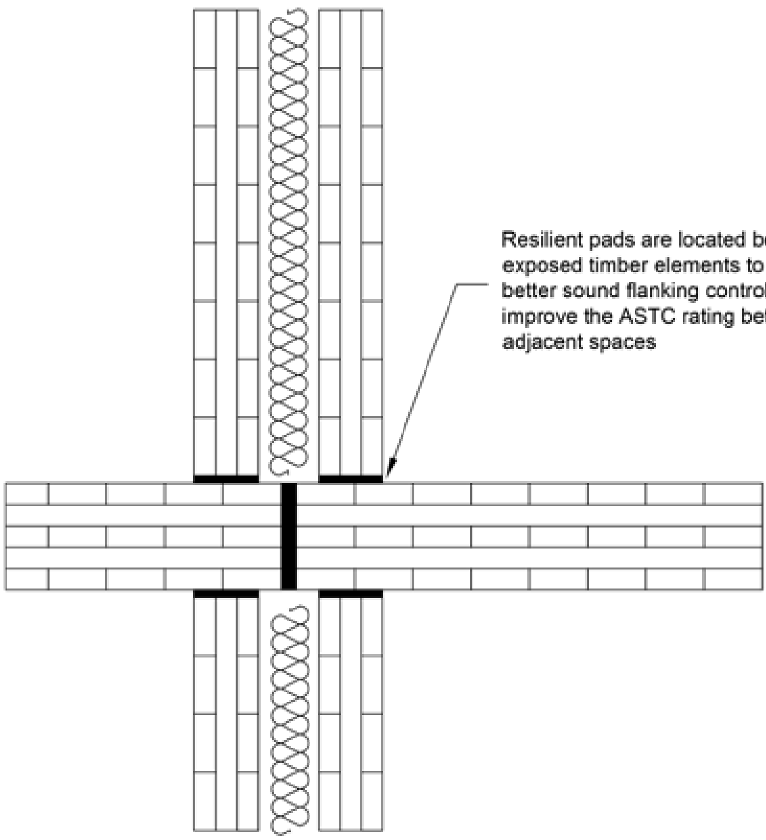
KEY ACOUSTICAL CONSIDERATIONS

Separate noisy and quiet spaces in the design: The location of noisy versus quiet spaces should be selected carefully to avoid the need for high levels of sound isolation. This principle can be applied to any type of building, but this is more important with exposed mass timber because sound flanking makes it more challenging to achieve high ASTC ratings. This can be accomplished in two ways:

Plan to have buffer spaces between any noise-generating space and a quiet one; for example, a fitness room in a residential tower should not be directly adjacent to a residential unit. At minimum, there should be one buffer space in between. The buffer space can be any area where noise is not a significant concern such as storage, quieter electrical/mechanical rooms, lobbies, or corridors. Early in the design, it is possible to either move the rooms around or build in a buffer in between.

Most mass timber buildings are hybrid construction, with concrete below grade and mass timber above. It is much easier to provide high STC ratings in the concrete construction, so as many loud spaces as possible should be located below grade or at grade in the concrete portion of the building.

Add resilient pads between structural timber elements: To avoid sound travelling to the adjacent horizontal room via the floor, it is necessary to provide breaks or discontinuities in the wood structure. This can be accomplished by adding resilient pads between structural elements such as between timber slabs and between the floor structure and shear walls or beams. If mass timber is going to be left exposed at the ceiling, the partitions should be laid out so STC-rated partitions line up with the joint between timber slabs wherever possible. Using a resilient pad between the timber slabs breaks the flanking path above the wall and will significantly increase the ASTC rating between rooms. This should be considered early in the design so that the structure and room locations can be coordinated to allow for high STC



partitions to line up with joints in the timber slabs

Incorporate decoupling elements into the wall or floor assemblies: These break the direct connection between one side of an assembly and the other and reduces the amount of noise that travels through the structure. This may include a mat or rubber floor underlay, as well as resilient wall connection elements like resilient channels. These have the double benefit of protecting the structure from flanking noise and also increasing the direct STC rating of the wall or floor assembly; however, this means that the timber will not be left exposed.

Don't bare it all: If you choose to leave a timber wall or ceiling exposed, do it selectively; for example, if a single CLT facade panel spans two adjacent rooms that require an STC-50 separation, it should only be left exposed in one room. This strategy should be used when it is not possible to have a joint in the mass timber which is common when several small rooms are located along the facade as these are likely to be spanned by a single facade panel.

Determine the right mass timber option: Not all mass timber is created equally so pick the one that is best suited for your needs and noise control. There are several options ranging from the type of timber to the thickness. Common types in Canada are CLT, NLT and DLT. There are very few laboratory test results for flanking noise but for overall noise control, controlled laboratory STC testing found CLT performs slightly better than other options as the laminates are cross-oriented in a panel and have less susceptibility for small holes and cracks.

Choose the right thickness of mass timber: More mass means better noise control in order to achieve the same sound levels expected from steel and concrete. This can be accomplished by selecting thicker mass timber. As thickness increases, both direct STC and flanking performance increases. If you're looking to expose the mass timber, seven-ply CLT would be much more effective than five-ply because as the thickness increases, so too does the STC rating. Keep in mind that while the thickness will impact your budget, it can reduce the floor topping and flanking control requirements which will have associated cost savings.

While dealing with flanking noise from mass timber construction is fairly new in North America, Europe is more experienced having been at the forefront of mass timber design. In fact, most of the products used for decoupling and improved sound flanking control come from Europe.

Much of the key learnings reflect the European experience. One of the biggest takeaways from all mass timber projects here and in Europe is the need to consider acoustics and flanking paths very early on in the process, particularly if there is a desire to incorporate an exposed mass timber wall or ceiling. There are ways to work it into the layout so any potential challenges are addressed at the outset rather than dealing with flanking issues later. If this is taken into account earlier in the process, it will be easier and cheaper to expose the timber.

If a project is well underway, and it is not possible to implement some of the solutions, the only option may be to install drywall to cover up the timber. This should be considered a last resort and can be avoided with proper planning. Trying to rectify flanking issues later in the design or after the building is built will be more difficult and likely more costly. It is possible to have good sound isolation in mass timber buildings as long as it is designed appropriately and early.

Wood WARE

The Future of Cars

Until the 1920s, cars were framed using wood. Today, as automakers strive to curb emissions by improving engines, streamlining design and reducing vehicle weight, one high-tech solution – ironically – could be wood; but this time, it is being used on a nanoscale.

A nanometer is one billionth of a meter. Cellulose nanofiber (CNF) is extracted from wood via chemical and mechanical processing, offering high strength and rigidity at one-fifth the weight of steel. In Japan, a team of 22 industry, government and academic institutions, led by Kyoto University, developed a vehicle featuring components made of wood-derived CNF.

The Nano Cellulose Vehicle (NCV) debuted at the 2019 Tokyo Motor Show. Commissioned by Japan's Ministry of the Environment, the project aimed to reduce vehicle weight 10 percent by replacing standard steel or aluminum parts with CNF. Thanks to strong government and industry funding, Japan has the world's largest CNF industry, and the material is being used in a variety of products. With the country's reputation as a leader in the automotive industry, it seems likely that this prototype is a glimpse at the future of cars.